Original Research

Improving Asthma Care in Rural Primary Care Practices: A Performance Improvement Project

Lisa Cicutto, RN, PhD, ACNP (CERT), CAE; Meg B. Dingae, MHSA, CCMEP; Esther L. Langmack, MD, FCCP, CCMEP

Introduction: *Rural areas are often underserviced health areas, lack specialty care services, and experience higher levels of asthma-related burden. A primary care, asthma-focused, performance improvement program was provided to a 6-county, rural-frontier region in Colorado to determine whether asthma care practices could be enhanced to become concordant with evidence-based asthma care guidelines.*

Methods: *A pre-post, quasi-experimental design was used. A complex, multifaceted intervention was provided to multidisciplinary primary care teams in practices serving children and adults with asthma. Intervention elements included face-to-face trainings, clinical support tools, patient education materials, a website, and clinic visits. Performance improvement and behavior change indicators were collected through chart audits and surveys from the entire health care team.*

Results: *Participants included three health care organizations and their staff in 13 primary care practices. Overall, all team members reported statistically significant improvements in confidence levels for providing quality asthma care. Chart reviews of asthma patient encounters completed before and after the program demonstrated statistically significant improvements in asthma care practices for asthma control assessment (1% vs 20%), provision of asthma action plans (2% vs 29%), controller prescription (39% vs 71%), inhaler technique assessment (1% vs 18%), and arrangement of follow-up appointment (20% vs 37%).*

Conclusion: *The asthma care–focused, multifaceted, complex, performance improvement intervention provided to rural primary health care teams lead to significant improvements in all indicators of quality asthma care provision to adults and children with asthma. However, significant barriers exist for rural practices to adopt evidence-based asthma care practices.*

Key Words: *experimental/quasi-experimental design, interprofessional education, performance improvement CE, asthma, rural, primary care*

Introduction

Primary care practices are challenged daily to provide evidence-based care to a diverse population affected by complex chronic illnesses.[1–4] Asthma is a common chronic disease that is inadequately controlled in up to 75% of patients.[5] Numerous asthma practice guidelines exist, such as the National Heart, Lung, and Blood Institute's (NHLBI's) National Asthma Education and Prevention Program (NAEPP) Guidelines for the Diagnosis and Management of Asthma,[6] to support best practices that lead to improved clinical outcomes.[7,8] A shortcoming of asthma guidelines is the limited access to tools and supports to follow recommendations.[9] To address this shortcoming, continuing medical education (CME) initiatives have begun to adopt the principles of performance improvement (PI) into their design, although currently for asthma care there is little evidence supporting their effectiveness. PI CME is a 3-stage, certified, educational activity in which clinicians learn about performance measures, assess their practice using those measures, implement interventions to improve their performance, and then reassess their practice on these measures once again. The stages are referred to as

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Dr. Cicutto: Director, Community Outreach and Research, Department of Medicine, National Jewish Health; Director, Clinical Science Graduate Program, University of Colorado Denver; *Ms. Dingae:* Manager, Educational Grants and Collaborations, Office of Professional Education, National Jewish Health; *Dr. Langmack:* Medical Director, Office of Professional Education, Director of Faculty and Community Education, Department of Medicine, National Jewish Health.

Correspondence: Lisa Cicutto, National Jewish Health, 1400 Jackson Street, G-08a, Denver, CO 80206; e-mail: cicuttol@njhealth.org.

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Baseline (Stage A), Intervention (Stage B), and Evaluation (Stage C).

Rural areas are known to be at risk for health disparities and are less likely to receive evidence-based care.[10] A rural region of Colorado characterized by a high level of asthma burden as indicated by the highest state rates for childhood hospitalizations and emergency department visits was selected for the program.[11] From 2002 to 2006, the hospitalization rates ranged from 185 to 277 per 100 000 for children ages 5 to 14 years and 57.7 to 99.6 for the 15 to 64 years age group.[11] Previous work completed in preparation for this project suggests a childhood asthma prevalence of approximately 14%, with 51% of children with asthma missing school in the preceding year and 58% requiring an urgent or unscheduled visit because of asthma in the past year (unpublished data)—rates much higher than the state's average.[11] This area is a federally designated Health Professional Shortage Area and a Medically Underserved Area with high rates of poverty (approximately 75% qualify for publicly funded health insurance programs) and a large Hispanic population (approximately 50%). Likely contributing factors to the high level of asthma burden are the lack of asthma specialists and asthma education or asthma care programs.

The purpose of this study was to evaluate a PI CME program targeted to primary care practices in this region to enhance the delivery of guideline-concordant, evidence-based asthma care with the ultimate goal of improving asthma control, thereby reducing the burden of asthma in this rural area. To that end, the program focused on education, skill development, and building a sustainable infrastructure, in order to increase the capacity of rural primary care practices to assess, treat, and manage asthma as directed by current evidence-based asthma guidelines. The primary research question addressed by the study was whether the implementation of a multidisciplinary and multifaceted PI CME program led to improvements in guideline-concordant care based on the following practice indicators: (1) use of spirometry to confirm the diagnosis of asthma and to assess asthma severity, control, and responsiveness; (2) assessment of asthma control; (3) recommended pharmacotherapy according to the NAEPP step-based approach; (4) review and coaching for accurate inhaler technique; (5) provision of written asthma action plans; and (6) advanced scheduling of a follow-up asthma appointment.

Methods

All 3 health care organizations in the region participated and provided input into all phases of the project (development, implementation, and evaluation) through interdisciplinary committees formed for each organization. The committees met regularly throughout the project to discuss and review elements of the program, implementation strategies, and the barriers encountered and possible solutions. Related to the developmental phase of the program, committees identified needed tools and resources, reviewed the literature, and decided on the best elements to meet the needs of the community. The lead author (LC) facilitated this process. After reviewing the literature on implementation and dissemination frameworks, PRISM (Practical, Robust Implementation and Sustainability Model) was selected for this initiative.[12] The model incorporates concepts from the literature about the diffusion of innovations, the Chronic Care Model, model for improvement and RE-AIM (reach, effectiveness, adoption, implementation, and maintenance).[13–15] PRISM takes into account the characteristics of the external environment, the implementation and sustainability infrastructure, the recipients of the intervention, and how these factors influence the adoption, implementation, and maintenance of the intervention/program. This innovative initiative is multifaceted to address these key factors.

Because the program targeted improving asthma care practices and closing existing gaps, the organizations felt that a randomized controlled trial was inappropriate and that all primary care practices should be able to participate and their patients, potentially, benefit. Therefore, a pre-post, quasi-experimental design was used. A quasi-experimental design was selected to determine whether the project had the intended effects but lacked components of a true experiment, such as a randomized controlled trial.[16] Our study used a pre-post design in that indicators of success were assessed before and after the program, but our program did not randomly assign and allocate health care providers and their patients to receive the project or not. All comers received the intervention so that the study lacks a control or comparison group. The existence of a randomly selected control group is the gold standard and provides the best evidence for determining whether the project had the intended causal effect; however, the partners did not see this option as feasible or desirable. The Institutional Review Board of National Jewish Health approved the study.

Setting

The 6-county, rural-frontier region targeted for intervention is the size of Connecticut and has a population of approximately 47 000 people. Of the 3 health care organizations, 1 is a federally funded community health center and the other 2 are hospitals with outpatient clinics. The 13 participating primary care clinics were located throughout the region and affiliated with 1 of the 3 participating health organizations. One clinic had 2 pediatricians, with the remaining practices staffed by family physicians, nurse practitioners, or physician assistants. The age range for primary care providers was approximately 30 to 70 years, with about 30% being of Hispanic descent. There is 1 solo, independent primary care

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TABLE 1. General Characteristics of Participating Clinics

	Organization 1	Organization 2	Organization 3
Clinics (#)	3 (1 Pediatric)	2	8
Organization Type	Hospital	Hospital	Federally Qualified Community Health Center
Providers (#)	11	7	22
Primary Care Provider Type (#)			
• **MD or DO**	7	4	8
• **PA**	4	2	12
• **NP**	0	1	2
Clinic Supports*			
• **Receptionist**	100%	100%	100%
• **RN**	0%	0%	38%
• **LPN**	67%	50%	75%
• **MA**	100%	100%	100%

*Percentage of clinics with this type of support staff.
Abbreviations: MD, medical doctor; DO, doctor of osteopathic medicine; PA, physician assistant; NP, nurse practitioner; RN, registered nurse; LPN, licensed practical nurse; MA, medical assistant.

practice in the region that was invited to participate but declined. Of the primary care practices in the region, 93% of clinics participated. Refer to TABLE 1 for specific details.

Program

The goal of the program was to provide quality asthma care to all patients (children, youth, and adults) in the region with asthma that is concordant with asthma practice guidelines.[6] EXHIBIT 1 provides the indicators of quality asthma care assessed in this project. These indicators were selected because the national asthma guidelines identify them as key elements to providing quality asthma care that leads to reduced morbidity, and they are identified as important benchmarks for addressing the continuum of asthma care.[6] Some aspects of the national asthma guidelines differ according to age, with the largest differences in treatment recommendations for young children and the determination of asthma control. These differences in recommendations between preschool, under 12 years, and over 12 years age groups were incorporated into many aspects of the program (clinical support tools, workshop content). To achieve our goal, a multifaceted program for the entire multidisciplinary team was developed and implemented. Refer to EXHIBIT 2.

EXHIBIT 1. Practice Improvement Indicators for Quality Asthma Care

Quality Asthma Care Indicators

- Spirometry to confirm the diagnosis of asthma and to assess asthma severity, control, and responsiveness.
- Assessment of asthma control at each visit (symptom frequency, nocturnal awakenings, frequency of quick-acting β_2-agonist use, interruptions in activity, and urgent care use)
- Provision of pharmacotherapy according to the NHLBI step-based approach (prescriptions for rescue/reliever medications and for controller medications)
- Regular assessment and coaching for accurate inhaler technique
- Provision of written asthma action plans
- Advanced scheduling of a follow-up asthma appointment

EXHIBIT 2. Elements of Quality Asthma Care Program

Program Elements

- Interactive, multidisciplinary workshops
- Asthma champion workshop for local clinic site leaders
- In-clinic coaching visits
- Clinician support tools
- Patient asthma education materials (English and Spanish) and teaching aids
- Resource website
- Provider practice feedback reports

Asthma champion workshop: Day-to-day leaders were selected by health care organizations from each clinic with some clinics selecting 2 champions: 1 physician and 1 clinic team member. In general, asthma champions were selected by their organization's administration because they thought they had the best leadership qualities for the clinic. Asthma champions included physicians, nurses, and medical assistants. Asthma champions attend a half-day workshop that included didactic information on practice improvement methods, leadership, and creating a culture of change, along with time to work within a team to apply learning. This workshop was held prior to the asthma care–focused workshops.

Asthma workshops: Three interdisciplinary, 3-hour workshops were designed to achieve sequential and incremental improvements in practice and broke down practice

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behavior changes requested for guideline-consistent care into smaller, achievable steps. All workshops had the same structural format: the first half provided an overview of the content required to support practice change, and the second half consisted of breakout sessions customized to address the differing educational needs of prescribing and nonprescribing team members. Breakout sessions included case-based discussions, hands-on skills acquisition, and role-playing. Forsetlund et al[17] report that mixed interactive and didactic education meetings are more effective than either didactic or interactive sessions alone.

In-clinic coaching visits: In-clinic coaching visits were provided to support all team members with the practical aspects of spirometry (equipment setup, troubleshooting), patient education provision, pharmacotherapy selection based on asthma control assessment, and workflow adjustment to accommodate new practice elements.

Clinician support tools: Printed, guideline-based support tools were provided to team members to support the integration of guideline recommendations into asthma care. Support tools developed for the project included spirometry quality checklist; asthma control assessment questionnaires for pediatric and adult age groups (based on the age tables provided in the NHLBI guidelines[6]); guide to NHLBI step-based asthma therapy, including asthma medications and dosages (this resource is part of the Colorado Asthma Guidelines; http://www.healthteamworks.org/guidelines/asthma.html); guides to assessing and coaching for accurate inhaler technique; asthma action plan templates (this resource is part of the Colorado Asthma Guidelines, http://www.healthteamworks.org/guidelines/asthma.html); patient education checklists; and a guide to communicating with and providing education to patients about asthma (based on the PACE program[18,19]).

Patient asthma education materials and teaching aids: Prior to the project, asthma patient education materials were nonexistent. Printed materials were created on topics that included how asthma is diagnosed (spirometry), asthma control, asthma medications, partnering with your asthma providers, asthma action plans, exercise-induced asthma, pregnancy and asthma, particulate matter, smoking cessation, and asthma triggers. Teaching aids were provided to support teaching effectiveness and included inhaler trainers, spacers, lung and airway models, and posters of all inhalers.

Resource website: A website was created to provide a one-stop-shop for access to all materials and resources that could be accessed either within or external to their electronic health record. Resources included all print materials, slide decks, PDFs of asthma guidelines (state and national), spirometry interpretation, and video clips to support practice changes.

Practice report cards: Participating primary care providers were given practice report cards regularly across the 18 months. Report cards provided the percentage of charts with the documented quality asthma care indicator. Each report card contained data specific to the provider as well as comparative data for his/her clinic and health care organization. Individual data were shared only with the individual and were coded: no names appeared on the report cards.

Resources and program elements developed for this initiative may be obtained by contacting the lead author.

Data Collection

A third party, external to the health care organizations and the PI CME organizers and investigators, collected data to evaluate the program as described below.

Workshop survey data: Workshop participants completed pre and post surveys for each workshop. Questionnaires elicited learners' confidence levels, current approach to asthma care, anticipated changes to asthma care approaches, goals of future practice, and overall workshop satisfaction. Confidence levels were assessed using a 5-point Likert scale that was collapsed into very/completely confident or somewhat/not/not at all confident.

Chart audit data: A pre- and postintervention audit of asthma patient charts was used to evaluate asthma practice patterns of primary care providers and clinic teams, and overall program effectiveness. Random selection of 10 to 15 asthma patient charts per provider per time point using administrative billing databases was used to perform the asthma patient chart audit. The chart audit included only unique patient charts; that is, the same asthma patient could not be included twice either for the same or a different provider. If fewer than 10 asthma patient charts were identified for a provider, then all asthma charts were pulled and reviewed. During the beginning of the study, electronic health records were not used; however, by the end of the program, all 3 health care organizations had implemented different electronic health record systems. Using a chart audit tool, 2 data abstractors were trained and performed all of the audits. Data were entered synchronously into a Health Insurance Portability and Accountability Act (HIPAA)–compliant, cloud-based database system, Track Via. No personal identifying information (for providers or patients) was entered. For both pre (August 2011 to October 2011) and post (August 2012 to October 2012) assessments, a 3-month retrospective assessment of asthma visits occurred. See EXHIBIT 1 for indicators. For each indicator, the chart abstractor identified whether the indicator was documented in the patient chart as being provided. Indicator

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variables were dichotomized as yes (provided) or no (not provided). In order for complete assessment of asthma control to be coded, all of the parameters listed under assessment of asthma control had to be documented (see EXHIBIT 1). If only some aspects were documented, it was coded as partial. If no parameters were documented, it was coded as not documented.

Self-assessment reflection survey data: A questionnaire was administered at the end of the program (18 months) to give participants an opportunity to reflect on accomplishments and challenges. Areas of assessment included self-reported approaches to providing indicators of quality asthma care, confidence in ability to provide the various elements of quality asthma care, barriers experienced, workflow changes as a result of the program, and the importance of the various educational and noneducational facets of the program.

Statistical Analysis

All quantitative data were analyzed using descriptive statistics. To determine whether differences occurred between baseline and post assessments for quality asthma care indicators (dichotomized data), differences in proportions were assessed by chi-square tests.[20] For each quality asthma care indicator, a chi-square test was used to determine if differences existed in the proportion of providers that provided or did not provide the action between baseline and post assessments. Because these data are nominal/categorical, the nonparametric statistic, chi-squared test was used.[20] For repeated assessments over time, a repeated measures analysis of variance (ANOVA) was performed. In this test, analysis variance techniques are extended to include situations where there are repeated assessments for participants.[21] P values less than .05 were considered statistically significant.

Results

Across the 3 workshops, 70 participants attended (73% reach or participation rate), with the following disciplinary breakdown: 18% doctors, 18% physician assistants or nurse practitioners, 62% nurses or medical assistants, and 2% other (eg, pharmacists, respiratory therapists). For the first (spirometry and asthma control) and second (asthma therapy) workshops, 100% of participants indicated that the workshops met their expectations and 85% indicated that the third (patient education and activation) workshop met their expectations.

Confidence in Ability to Provide Quality Asthma Care

Following the workshops, all participants (primary care providers and their team members) reported improved confidence in their ability to provide quality asthma care improvements that were sustained at 18 months. For details, refer to TABLE 2. For several of the skills, confidence levels continued to improve over time, including the ability to assess asthma control, identify asthma severity, provide asthma education, assess and coach for accurate inhaler technique, demonstrate accurate inhaler technique, and provide team-based asthma care. Areas that demonstrated a falling off in confidence levels over time included interpreting spirometry, coaching for accurate spirometric maneuvers, and provision and explanation of written asthma action plans. Some variance was observed between primary care providers and their team members. For instance, primary care providers started with higher confidence levels in their ability to provide team-based care that peaked following the workshops but fell off at the 18-month assessment, whereas primary care team members started off with lower confidence levels that continued to improve over time and surpassed the primary care provider levels at 18 months.

Self-Reported Asthma Care Provision Practices

Overall, respondents increasingly reported providing elements of quality asthma care to at least 60% of their asthma patients. These trends were most pronounced for the provision of asthma education materials, assessment and coaching for accurate inhaler technique, provision and review of a written asthma action plan, scheduling a follow-up asthma appointment, and provision of team-based asthma care. Interesting observations were noted in pharmacotherapeutic approaches reported by primary care providers. At baseline, primary care providers reported that they were almost always providing pharmacotherapy according to the patient's level of asthma control. However, following the workshop, this proportion of patients decreased and never returned to baseline levels. Also of note, the percentage of patients prescribed an inhaled steroid and a quick-relief inhaler taken as needed remained relatively stable, while the prescription rate of antileukotrienes decreased.

Chart Audit Documented Asthma Care Provision

In total, 767 charts were reviewed, 430 for the baseline audit and 337 for postintervention assessment. The discrepancy in the number of charts reviewed between baseline and postintervention assessment is related to the loss of 10 providers from the organizations between assessments. This region is known to experience an annual provider turnover of 25% to 30%. During the baseline period, we identified an 8% diagnostic coding error. An asthma coding error occurred when the administrative billing database identified asthma as the reason for the visit, but, after review of the chart, there was no information to suggest the patient had asthma (no asthma medication use or symptoms suggestive of asthma). This

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TABLE 2. Confidence Levels of Primary Care Providers and Team Members for Asthma Care Skills Immediate Pre and Post, and 18 Months Workshop: Percentage of Respondents Very or Completely Confident

Skill	% Pre Workshop	% Post Workshop	% 18 Months Post Workshop	*P* value (≤)
Primary care providers (MD, DO, PA, NP)				
Assess asthma control	26	68	73	.05
Identify asthma severity	22	83	90	.001
Interpret spirometry	33	100	27	.01
Recommend pharmacotherapy based on asthma control (NHLBI step-based approach)	69	100	98	.01
Assess and coach for accurate inhaler technique	50	72	95	.01
Demonstrate accurate inhaler technique	52	78	92	.01
Provide and review written asthma action plan	47	100	75	.01
Provide asthma education materials to support visits	0	70	78	.001
Provide team-based asthma care	43	100	77	.01
Primary care team members (nurses, medical assistants)				
Assess asthma control	22	70	88	.001
Correctly coach spirometry	41	79	63	.01
Assess and coach for accurate inhaler technique	22	88	98	.001
Demonstrate accurate inhaler technique	52	78	90	.01
Engage in interactive conversation	33	89	90	.001
Explain/review written action plan	37	81	69	.01
Provide asthma education materials to support visits	0	50	100	.001
Provide team-based asthma care	23	79	85	.001

Abbreviations: MD, medical doctor; DO, doctor of osteopathic medicine; PA, physician assistant; NP, nurse practitioner.

information was provided to the partnering organizations, and, for subsequent chart reviews, less than 1% of charts had a diagnostic coding error. TABLE 3 displays practice provision goals set for each quality asthma care indicator established by an interdisciplinary committee after reviewing baseline data. The disciplines represented on the committee included physicians, nurse practitioners, nurses, respiratory therapists, medical assistants, pharmacists and administration. During the study, goals were met or exceeded for only two indicators: prescriptions for a controller medicine and provision/review of an asthma action plan. However, all indicators showed significant improvement.

Objective measures of lung function are important to the diagnosis and treatment of asthma but were used for 3% of asthma patients before the intervention. At post assessment, 14% of patients had spirometry completed at least once. This is well below the target goal of 50% and reflects, in part, the considerable barriers related to equipment, personnel, interoperability with electronic health records, and workflow redesign issues.

Asthma control assessment is essential to the successful management of asthma. Prior to the intervention, 59% of charts had at least 1 parameter of asthma control assessed, and only 1% had a complete asthma control assessment documented. At post assessment, 67% had at least 1 asthma control parameter documented, and 20% had complete asthma control assessments documented.

Medication provision improved over the course of the initiative. The provision of a PRN albuterol inhaler increased from 55% to 94% of charts, very nearly meeting the target goal of 100%. The provision of a prescription for controller therapy increased from 39% at baseline to 71% at

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TABLE 3. Chart Audit for Documented Provision of Asthma Care Indicators

Indicator	Baseline ($n = 430$)	Post ($n = 337$)	Goal	P value
Spirometry*	3% (13)	14% (47)	50%	.001
Asthma control PARTIAL	59% (255)	67% (225)	N/A	.01
Asthma control COMPLETE	1% (6)	20% (67)	50%	.001
PRN reliever inhaler	55% (238)	94% (317)	100%	.001
Controller medicine	39% (168)	71% (238)	60%	.001
Inhaler technique	1% (5)	18% (60)	100%	.001
Asthma action plan	2% (8)	29% (99)	15%	.001
Follow-up asthma visit	20% (87)	37% (123)	50%	.001

*Peak expiratory flow rates were included as a measure of objective lung function at baseline assessment only.

post assessment, which exceeded the target goal of 60%. This information is somewhat different from what was noted in the self-reported approaches to asthma care questionnaire that observed lower levels of use for inhaled steroids and PRN albuterol (TABLE 4).

Patient education and follow-up are essential components of quality asthma care. Improvements were observed for providing inhaler technique assessment and teaching from 1% to 18%, provision and/or review of written asthma action plans from 2% to 29%, and for the arrangement of a follow-up appointment for asthma care at the current visit from 20% to 37% of visits.

Discussion

Significant and clinically meaningful changes were observed for guideline-concordant asthma care through the implementation of a multifaceted, asthma-focused, PI CME program provided to multidisciplinary primary care teams in a rural, underserved region of Colorado. TABLE 3 demonstrates the significant multiple-fold increases observed for the documented provision of performing a complete assessment of asthma control, the review and coaching for accurate inhaler technique, and the provision of written asthma action plans. Chart audit data also suggested that providers approached asthma care in a more proactive manner, as reflected by a doubling in the rate of scheduled follow-up visits, while the proportion of visits for an asthma exacerbation decreased by 30% and by 83% for follow-up visits following an exacerbation. To support these newly adopted practices, TABLE 2 shows the significant improvements in reported confidence levels of the whole interdisciplinary team, which were most notable for assessing asthma control and severity, providing asthma education, providing and reviewing the written asthma action plan, and working as a team to deliver quality asthma care. Overall, self-reported data and chart audits show similar trends and the self-reported improvements in confidence are consistent with practice changes identified through chart audits. The approach of using both chart audits and self-reports was beneficial to understanding a richer picture of the intervention. Although not reported above, 94% of providers reported that their asthma care improved as a result of the program. Our evaluative efforts demonstrate that providers were engaged in a variety of educational program components and that their confidence and practice patterns for diagnosing, monitoring, and treating patients with asthma improved.

Our study acknowledges limitations. A randomized controlled trial is superior in design but was unacceptable to the program team because of the need for an intervention available to the whole community, not just those randomized to intervention. A study strength is that the results from self-reports and chart audits are consistent in demonstrating modest improvements. In an attempt to minimize study bias, an external third party conducted chart audits of randomly selected charts. The representativeness and sample size of primary health care provider participants is strong in that only 1 solo primary practice with 1 physician in the area did not participate, and chart audits were pulled for all primary health care providers with prescriptive authority at the participating sites. It is estimated that there are 4700 people with asthma (based on a 10% overall prevalence rate) in the region, and the study reviewed the documented asthma care for 767 people with asthma, representing 6% of the expected total population of individuals with asthma. The high participation rate of health care providers in our study suggests that our work is likely generalizable to other rural, underserviced areas. Although we noted that improvements tended to occur over time, it is unclear if these improvements will be sustained with the withdrawal of active support. To assess this, we are collecting data related to asthma hospitalizations and urgent and emergent care visits for the year following the withdrawal of active program support.

Despite our great strides and achievements, several barriers were encountered along the journey. We knew that increasing provider knowledge, skills, and motivation to improve asthma care were by themselves insufficient, but we did not anticipate many of the challenges encountered, mainly in the area of infrastructure and organizational systems. The most significant challenges encountered were issues with spirometric equipment, electronic health records, communication and coordination within organizations, high rates of personnel turnover, and competing organizational priorities.

Issues with spirometric equipment provide a good illustrative example of challenges. At the beginning of the

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TABLE 4. Self-Reported Asthma Care Practices of Primary Care Providers and Team Members: Percentage of Respondents Indicating That ≥ 60% of Asthma Patients Received the Element of Care

Elements of Asthma Care	% Pre Workshop	% Post Workshop	% 18 Months Post Workshop	*P* value (≤)
Primary care providers (MD, DO, PA, NP)				
Assess asthma control	41	73	68	.05
Teach monitoring of asthma control	27	36	46	.05
Spirometry	27	18	55	.05
Recommend quick-acting bronchodilator, PRN	64	53	76	NS
Recommend inhaled steroid	58	49	60	NS
Recommend antileukotriene	20	17	10	.05
Recommend pharmacotherapy based on asthma control (NHLBI step-based approach)	100	64	70	.05
Provide asthma medication education	45	29	73	.05
Assess and coach for accurate inhaler technique	25	43	59	.01
Provide and review written asthma action plan	7	15	43	.001
Provide asthma education materials to support visit	0	23	73	.001
Schedule follow-up appointment	36	36	71	.01
Provide team-based asthma care	6	15	68	.001
Primary care team members (nurses, medical assistants)				
Assess asthma control	21	36	72	.001
Teach monitoring of asthma control	25	29	65	.01
Perform spirometry	18	21	21	NS
Provide asthma medication education	29	30	64	.01
Assess and coach for accurate inhaler technique	12	22	66	.001
Provide asthma education materials to support visit	0	36	78	.001
Schedule follow-up appointment	36	42	71	.01
Provide team-based asthma care	15	29	76	.001

Abbreviations: MD, medical doctor; DO, doctor of osteopathic medicine; PA, physician assistant; NP, nurse practitioner.

project, none of the clinics had spirometers. Significant effort was therefore devoted to selecting and setting up spirometric equipment. Unfortunately, this proved impossible in some clinics. One organization selected a spirometer because it was marketed as interfacing seamlessly with their electronic health record. However, when the spirometer was tested at National Jewish's reference pulmonary physiology lab, numerous deficiencies were identified. Company representatives were contacted, and they acknowledged the problems. Eight months later, the spirometry software was updated, but it was no longer compatible with the organization's electronic health record, which was the reason for selecting the not-so-user-friendly spirometer. In fact, testing the spirometer, twice, crashed the entire electronic health record throughout the organization's clinics. Workarounds for the software were developed, but the setup and use of the equipment severely lagged behind the clinics that selected the more user-friendly spirometers. Even in clinics with easier-to-use spirometers, implementation proceeded very slowly, but at the end of the study period, implementation was rising quickly. Our data over the course of the project indicate that the training on coaching for accurate spirometry and the interpretation of spirometry were effective. In fact, after our training, 100% of providers felt confident in their ability to

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interpret results from spirometry. However, at the end of our project, this had fallen to 27%, which represents the proportion of providers that have functioning spirometers in the their office that were being used. Participants explained that due to huge delays in setting up the equipment, they needed a refresher on interpreting spirometry because it had been so long since they applied the principles learned. We have since provided an online refresher tutorial for spirometry that is used by providers and also offer support from National Jewish staff to support interpretation of spirometry.

Our study is consistent with previous work demonstrating that PI CME is effective in influencing practice changes, as indicated by both self-report and performance measures.[22–24] Specific to interventions to modify provider adherence to asthma practice guidelines, our work supports and extends the observations of a recent systematic review[25–27] that multicomponent interventions can result in moderate improvements in prescription of controller medications and provision of asthma education and asthma action plans. Our study observed a 32% increase in the proportion of patients prescribed an inhaled corticosteroid (a controller therapy). Of note, fewer participants reported prescribing antileukotrienes for their patients. This may represent a shift in the use of preventive anti-inflammatory medication from nonsteroidal to steroid-based therapy. Large, randomized, controlled trials suggest that starting a patient with persistent asthma on an inhaled corticosteroid can reduce patient emergency department visits and hospitalizations by 50%.[28,29] Our work extends these observations by noting significant improvements of moderate magnitude in asthma control assessment, assessment and coaching for accurate inhaler technique, and the arrangement of regular proactive follow-up asthma care, all of which are key recommendations of the guidelines.[6] Despite higher rates of asthma burden and access issues to specialty care, few studies exist evaluating CME initiatives in rural primary care settings. The overwhelming majority of programs occur in academic and urban settings.[22,25,26] Our work demonstrates that PI CME initiatives can be implemented with comparable effectiveness in underserviced, rural areas.

In addition, our work supports and extends previous observations that improved practice performance has occurred through greater teamwork and that the appropriate target of an intervention may be a team rather than an individual.[24,29] Our work supports the value of identifying shared indicators of quality care, the advantage of a multidisciplinary approach, the importance of sustaining motivation through multiple encounters for learning (clinic visits and interactive workshops), and the need to allow sufficient time to enable the initiative to evolve and take hold.[30] Interest in interprofessional education and clinical supports is recent and our study recognizes this as an important component of new approaches to continuing education that are needed to increase health professionals' ability to improve processes and outcomes of care.

Our project incorporated the learnings and effective elements of multiple models that included PRISM, the Chronic Care Model, model for improvement, and RE-AIM.[12–15] The use of this combined model guided and permitted the tailored development and implementation phases that took into account the characteristics of the external environments, the implementation and sustainability infrastructure, and the needs and preferences of the interdisciplinary asthma care team. This resulted in an effective, innovative, and multifaceted initiative that improved multiple quality care indicators along the asthma care continuum. Asthma is one of many common chronic conditions for which primary care teams are championed to deliver quality care. Based on interviews with providers, lessons learned throughout this project extend beyond their asthma care practice and into their care of diabetes and hypertensive patients through the use of a team-based approach with identification of important care indicators. An important next step would be to determine whether the benefits of this multifaceted, multidisciplinary approach for improving guideline concordant care of primary care teams extend beyond asthma into other chronic conditions such as hypertension, congestive heart failure, and diabetes.

Lessons for Practice

- Don't underestimate the importance of consistent, continuous, and reinforcing communication to all parties involved (from administration to receptionist levels).
- Each practice or clinic site has its own patterns of behavior, so work with them to customize approaches while providing guideline concordant care.
- Don't make any assumptions. Discuss processes for all aspects of the program to highlight workflow issues and potential barriers. Put your feet on the ground to understand the milieu, culture, and system.
- Engage partners throughout all stages of the process, provide regular updates, and seek their opinions about approaches and problem solving.

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